

the average pull rate profile of Cope is determined by the upper and lower imposed limits thereon." (Office action at page 3).

The Cope reference discloses a conventional method for controlling silicon crystal growth that requires independent closed loop control of each of melt temperature, melt level, and diameter. (See Cope, col. 4, lines 50-56). Those skilled in the art understand that the conventional control methods require varying the pull rate in response to diameter error because temperature dependent methods are too slow in responding. Consistent with this understanding, Cope discloses a method for controlling pull rate in response to diameter changes that includes: "[a] controller 65 to maintain a crystal pull rate specified by [the] diameter control algorithm." (Cope, col. 5 lines 5-10); "the output of the diameter control algorithm is input to the averaging filter 84 in order to provide the average pull rate for the crystal rod as it is pulled." (Cope, col. 5, lines 31-32); and "a diameter control algorithm. . . receives inputs from sensing devices and calculate[s] set point signals for the respective controllers." (Cope, col. 2, lines 60-62).

In contrast, Applicants' claim 1 recites a method for controlling silicon crystal growth in which an ingot is pulled from the melt at a target rate "substantially following a velocity profile, said velocity profile *stored in memory* and defining the target pull rate," in combination with "defining a temperature model representative of variations in the temperature." In particular, Applicants have defined relationships between diameter variations and melt temperature, and between melt temperature and heater power to achieve diameter control *without the need to vary or correct pull rate in response to diameter variations*. (See application, page 21). Thus, as described in Applicants' patent application, adjusting the pull rate in response to changing process conditions (i.e., diameter) is unnecessary because the velocity profile stored in a memory defines a target pull rate. Neither the Cope patent nor the Araki patent make any mention whatsoever of determining a crystal pull rate without sensing diameter.

The Examiner asserts that maintaining the crystal pull rate specified by the diameter control algorithm reads on pulling at a target rate which substantially follows a set velocity profile. (See Office action at page 2). However, a prior art reference must be considered in its entirety, including those portions that would lead away from the invention. *W.L. Gore &*

Associates, Inc. v. Garlock, Inc., 721 F.2d 1540 (Fed. Cir. 1983). The Examiner acknowledges that Cope discloses determining the pull rate as function of the diameter control algorithm. In fact, the Examiner cites a portion of the Cope reference disclosing that the sensed diameter is provided to the diameter control algorithm to determine the pull rate of the crystal. (See Office action at page 3, citing col. 5, lines 1-11). Rather than sensing the diameter to determine a velocity profile and, thus, the pull rate, Applicants disclose a velocity profile stored in memory having predetermined pull rate. A system that discloses determining a crystal pull rate as a function of the sensed diameter during processing inherently teaches away from a system that discloses pre-determining the crystal pull rate. Accordingly, Applicants submit that the Examiner has failed to consider the Cope reference in its entirety and has ignored those portions that would lead away from the invention. In as much as the Cope reference teaches away from Applicants' claim 1, this claim is believed to be allowable.

Likewise, the Examiner's assertion that "the pull rate adjustment reads on the application's substantially following a set velocity profile" ignores portions of the Cope reference that lead away from Applicants' invention. (Office action at page 2). The upper and lower imposed limits disclosed in the Cope reference are related to upper and lower limits for the average pull rate as determined from the averaging filter after receiving input from the diameter control algorithm. (Cope, col. 5, lines 21-45). In other words, the upper and lower imposed limits disclosed in the Cope reference do not determine pull rate, but rather limit the pull rate as determined by the averaging filter 84. Moreover, as described above, the averaging filter 84 receives input from the diameter control algorithm, and the diameter control algorithm receives inputs from sensing devices (i.e., diameter sensors). In contrast, Applicants' pull rate is implemented independent of diameter changes, and it is therefore unnecessary to set upper and lower limits for a pull rate determined as a function of diameter changes. Thus, Applicants submit that the Examiner has not considered the Cope reference in its entirety, and has ignored those portions of the Cope reference that would lead away from the invention.

The Examiner further asserts that the Applicants' upper and lower boundaries are merely the same value. (See Office action at 6). However, if a proposed modification of a prior art

reference changes the principle of operation of the prior art invention being modified, then the teachings of the reference are insufficient to render the claims prima facie obvious. *In re Gordon*, 733 F.2d 900 (Fed Cir. 1984). In this case, if the upper and lower limits are set to the same value "x," there is no need for the diameter control algorithm or averaging filter because the average pull rate will be always be defined as "x." Thus, the proposed modification would change the principle of operation of the Cope reference and, therefore, is insufficient to render claim 1 obvious.

Furthermore, the Examiner's assertion that the Applicants' upper and lower boundaries are merely the same value is clearly based on improper hindsight reasoning. Applicants recognize that a judgment on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning, and is proper so long as it takes into account only knowledge that was in the level of ordinary skill in the art at the time the claimed invention was made. *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971). Nevertheless, such reconstruction cannot include knowledge gleaned only from Applicants' disclosure. *Id.* Although it is possible that the upper and lower pull rates could be set to the same value, the proper inquiry is whether the Cope reference teaches or suggests setting the upper and lower limits equal to the same value. However, as discussed above, setting the upper and lower limits equal to the same value would change the principle of operation of the Cope reference. Thus, the Examiner's conclusion that setting upper and lower limits to the same value is related to a profile stored in a memory is gleaned solely from Applicants' disclosure and constitutes improper hindsight analysis.

For these reasons, Applicants submit that claim 1 is allowable over the cited art. Claims 2-10 depend from claim 1 and are believed to be allowable for at least the same reasons as claim 1.

In view of the foregoing, Applicants submit that the prior art references in no way suggest the desirability of "substantially following a velocity profile, said velocity profile stored in memory and defining the target pull rate" as reflected in Applicants' claims. See MPEP 2143.01 (explaining that the prior art must suggest the desirability of the claimed invention). Indeed, the Cope reference teaches away from Applicants' invention. See MPEP 2141.02 (explaining that a

prior art reference must be considered as a whole, including that which teaches away from the claimed invention). Applicants submit that claims 1-10 are in condition for allowance and respectfully request favorable reconsideration of this application.

It is believed that a full and complete response has been made to the Office action and, as such, the application is in condition for allowance. Such allowance is hereby respectfully requested.

Enclosed is a check for \$110.00 to cover the fee for a one month extension of time up to and including today's date.

The Commissioner is hereby authorized to charge any fees that may be required during the entire pendency of this application to Deposit Account No. 19-1345.

Respectfully submitted,



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*Enclosure